Curs 03 PSS

① **FIR**
$$H(z) = b_0 + b_1 z^{-1} + b_2 z^{-2} + \dots + b_M z^{-M} \quad \overset{z}{\longleftrightarrow} \quad h[n] = \{ b_0, b_1, b_2, \dots b_{M} \}, 0, 0, \dots$$

$h[0] \quad h[1] \quad h[2] \qquad h[M]$

$$= b_0 \cdot (1 - z_1 \cdot z^{-1})(1 - z_2 \cdot z^{-1}) \cdots (1 - z_M \cdot z^{-1})$$

$\underbrace{\qquad}_{H_1(z)}$ _zerourile sistemului_ $\underbrace{\qquad}_{H_3(z)}$ $H_2(z)$

$$y[n] = b_0 \cdot x[n] + b_1 \cdot x[n-1] + \dots + b_M \cdot x[n-M]$$

Forma directă
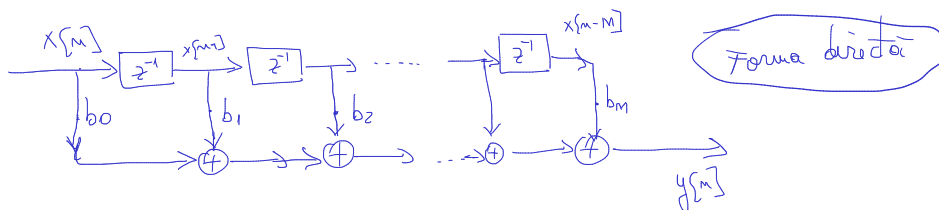
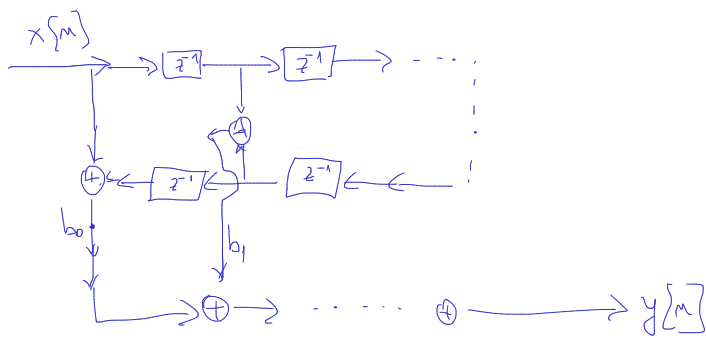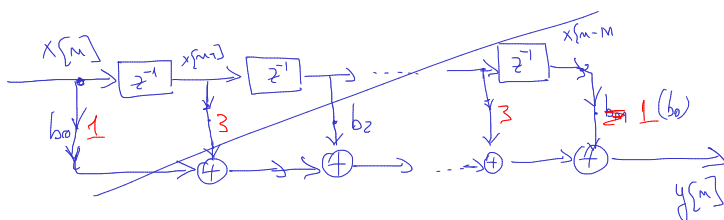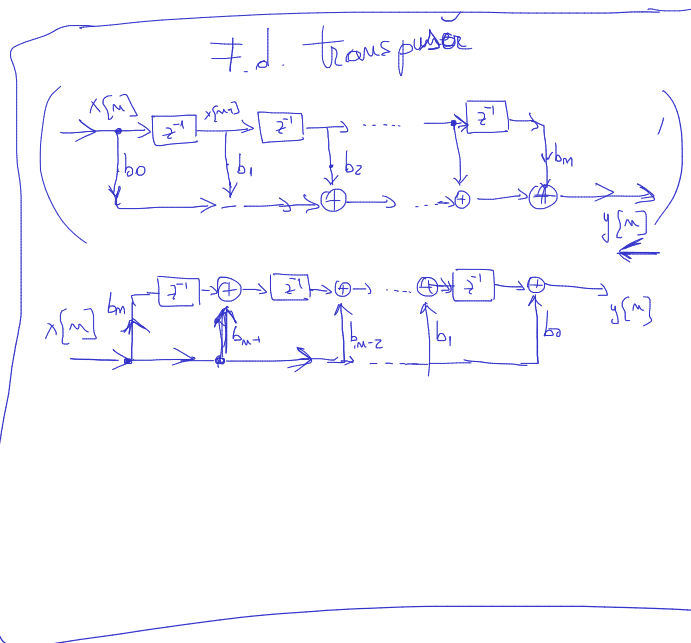## Optimizare pt. filtre cu fază liniară:

$$h[n] = \pm h[M-n]$$

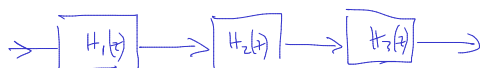$$h[n] = \{ \underline{1}, 3, 2, 4, 2, 3, 1 \}$$

$$h[n] = \{ 1, 3, 2, 0, -2, -3, -1 \}$$

#.d. transpusă

Serie (cascadă)

$$H(z) = H_1(z_1) \cdot H_2(z) \cdots H_K(z)$$

Ex:
$$H(z) = 1 + 3z^{-1} + 2z^{-2} + 4z^{-3} + 2z^{-4} + 3z^{-5} + z^{-6}$$

roots()
$$= \left(1 + 2.7515\, z^{-1}\right)\left(1 - (0.4304 + 0.9j)z^{-1}\right)\cdot \left(\quad -0.9j \right) \cdot$$

$H_2(z)$

$$\left(-0.3 + 0.9j \right) \cdot \left(-0.3 - 0.9j \right) \cdot \left(\quad -0.363\, l \right)$$

$H_1(z)$ $H_3(z)$

$$H_1(z) = \left(1 + 2.7515\, z^{-1}\right)\left(1 + 0.3634\, z^{-1}\right) = \boxed{1} + 3.115\, z^{-1} + \boxed{1}\cdot z^{-2} \quad \checkmark$$

$$H_2(z) = \left(1 - (0.4304 + 0.9026 j)\cdot z^{-1}\right)\cdot\left(1 - (0.4304 - 0.9026 j)\, z^{-1}\right) = \boxed{1} - 0.8608\, z^{-1} + \boxed{1}\, z^{-2}$$

$$H_3(z) = \left(1 - (-0.3729 + 0.9279 j)\, z^{-1}\right)\cdot\left(1 - (-0.3729 + 0.9279 j)\, z^{-1}\right) = \boxed{1} + 0.7458\, z^{-1} + \boxed{1}\cdot z^{-2} \quad \checkmark$$

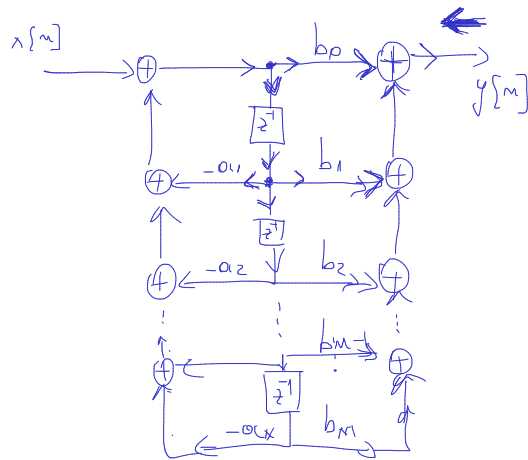IIR :
$$H(z) = \frac{b_0 + b_1 z^{-1} + \ldots + b_M z^{-M}}{1 + a_1 z^{-1} + \ldots + a_N z^{-N}}$$

$$y[n] = -a_1 y[n-1] - \ldots - a_N y[n-N] + b_0 x[n] + \ldots + b_M\cdot x[n-M]$$
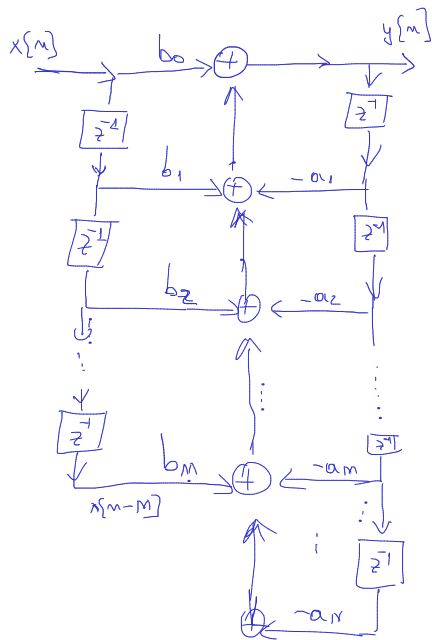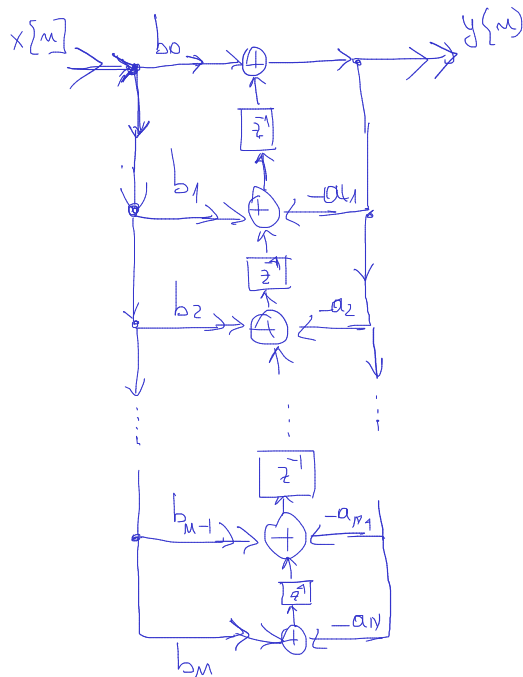
Forma directă 1

Forma directă 2 (forma canonică)

F. d. 2 transpusă

Forma serie:

$$H(z) = H_1(z) \cdot H_2(z) \cdot \ldots \cdot H_k(z)$$
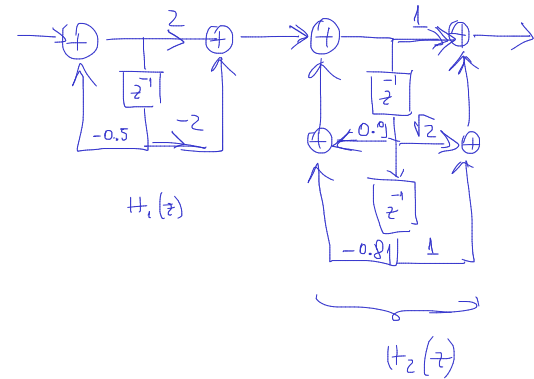
ordinul z ↓

$$H(z) = \frac{2(1 - z^{-1})(1 + \sqrt{2}z^{-1} + z^{-2})}{(1 + 0.5z^{-1})(1 - 0.9z^{-1} + 0.81z^{-2})}$$

$H_1(z)$ $H_2(z)$

$H_1(z)$

$H_2(z)$

Forma paralel

$$H(z) = H_1(z) + H_2(z) + \ldots + H_k(z)$$

$$\frac{A_1}{z - \sigma} + \frac{A_2}{z - \sigma_1}$$

$x[n]$

$y[n]$

$H_1(z)$
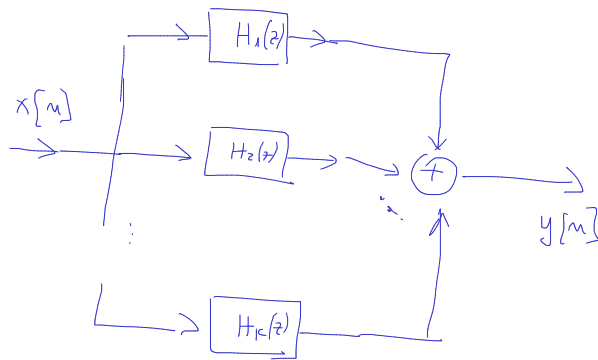
Exemplu

$$H(z) = \frac{5 - 6z^{-1} + 3.72z^{-2} - 0.74z^{-3}}{1 - 1.5z^{-1} + 1.24z^{-2} - 0.37z^{-3}} = 2 + \frac{1}{1 - 0.5z^{-1}} + \frac{2 - z^{-1}}{1 - z^{-1} + 0.74z^{-2}},$$

$H_1(z)$ $H_2(z)$ $H_3(z)$

$x[n]$

$y[n]$